

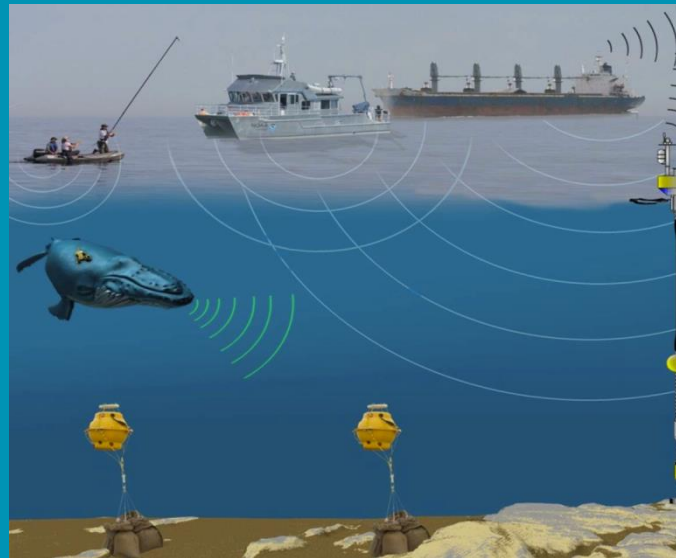
# Listening to Our Sanctuaries

**Leila Hatch**

*ONMS*

*Stellwagen Bank*

*National Marine Sanctuary*



**Kathy Broughton**

*ONMS*

*Conservation Science Division*

**OCNMS Sanctuary Advisory Council Meeting**

*Olympic Coast National Marine Sanctuary*

*November 6, 2015*

# OUTLINE

- **Ocean Noise: What's the Problem?**
- NOAA Ocean Noise Strategy
- ONMS & Ocean Noise
- OCNMS & Noise

# Sound is Critical to Marine Animals

Hearing: *Gather* information over a wide range of distances

Sound: *Communicate* information over a wide range of distances

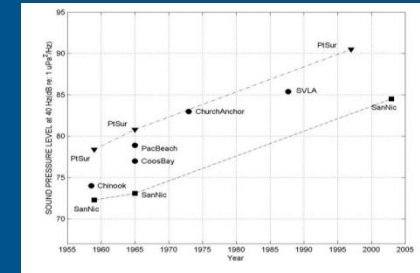
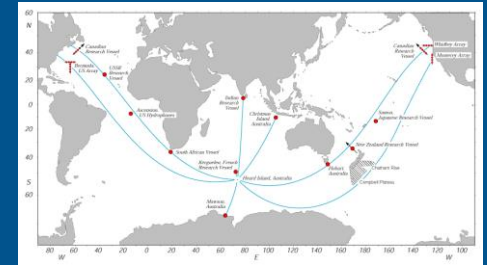
How to animals *use* sound?

- Locate and select mates
- Find food
- Avoid predators
- Navigate
- Maintain group structure & relationships
- ...more as we learn!



# Anthropogenic Ocean Noise

- Humans produce noise
- Noise can travel across ocean-basins
- Coastal & ocean waters are getting noisier
- Ocean noise is a growing global problem for marine ecosystems
- Acute
  - Intense noise events
  - Adverse physical and behavioral impacts
  - Impact health and fitness
- Chronic
  - Rising background noise
  - Limits communication range and ability to sense environment





# It's Not Just About How Loud It Is

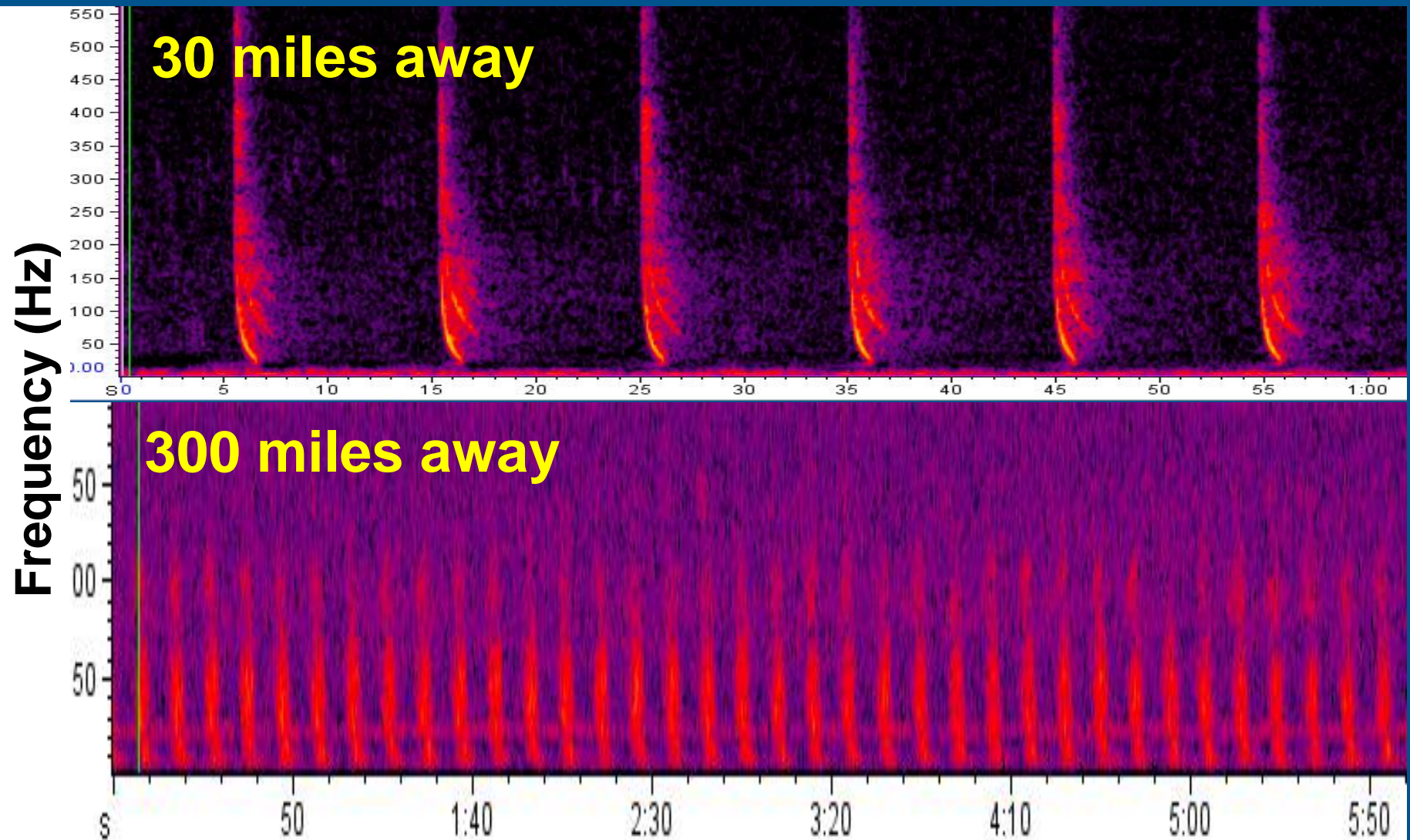
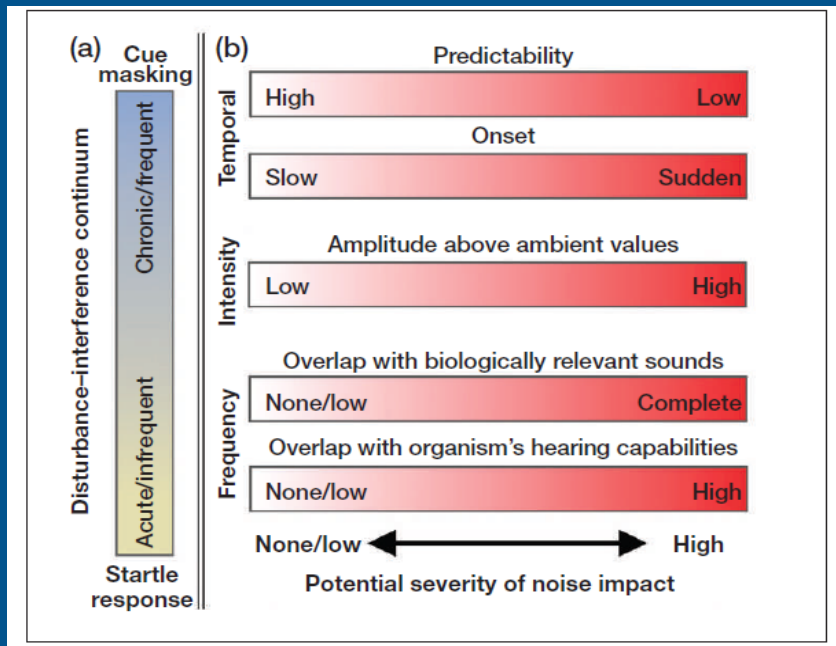
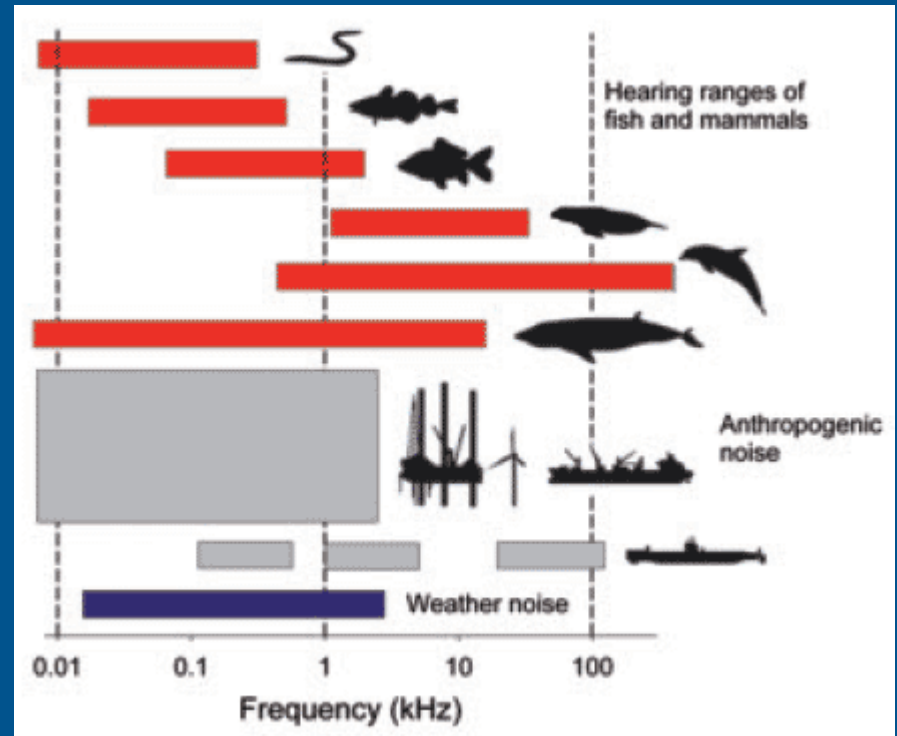


Figure: Chris Clark, Cornell University Bioacoustics Research Program

# It's Not Just About How Loud It Is

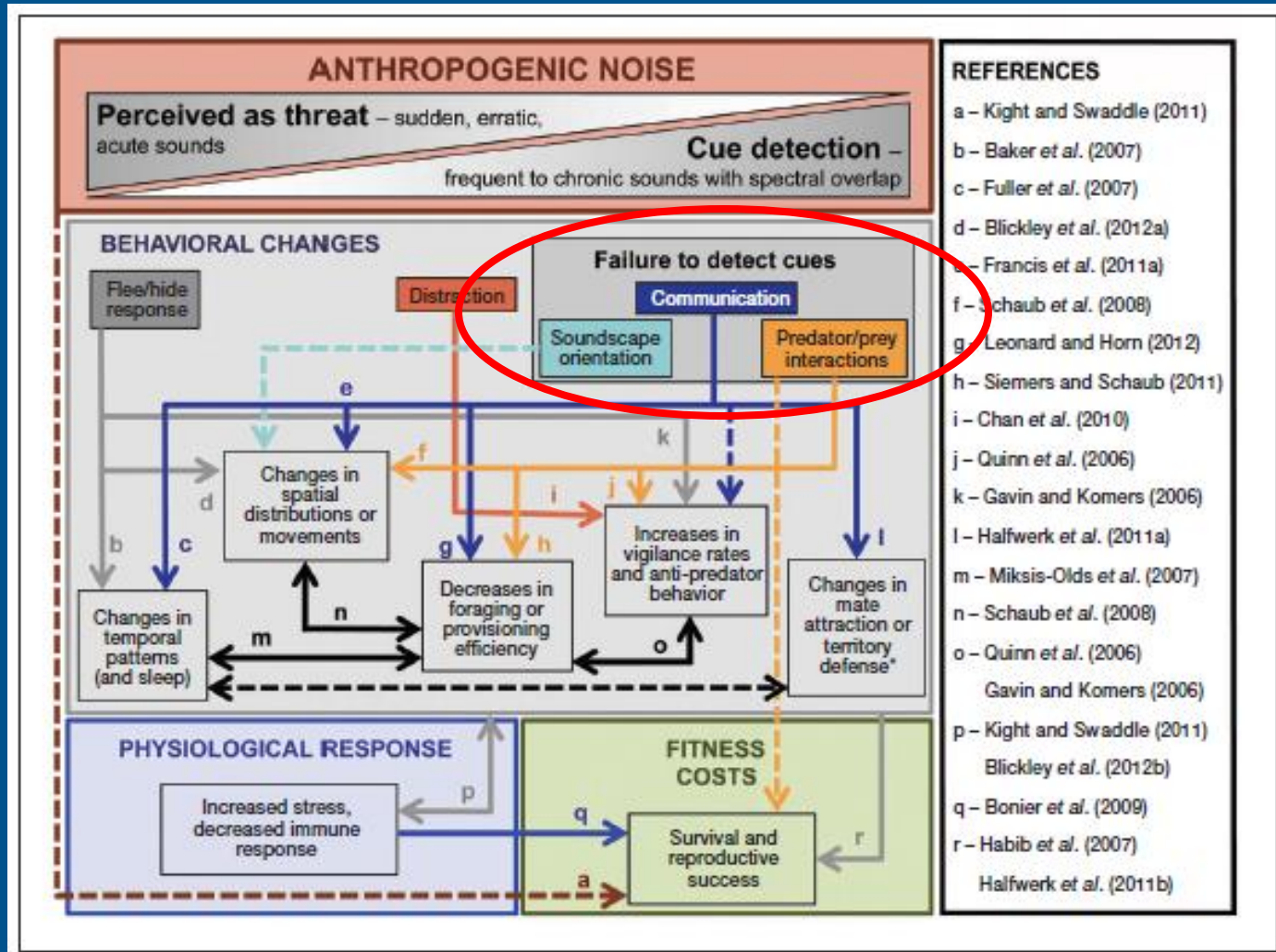


Francis & Barber (2013) *Frontiers in Ecology*



Slabekoorn et al. (2010)

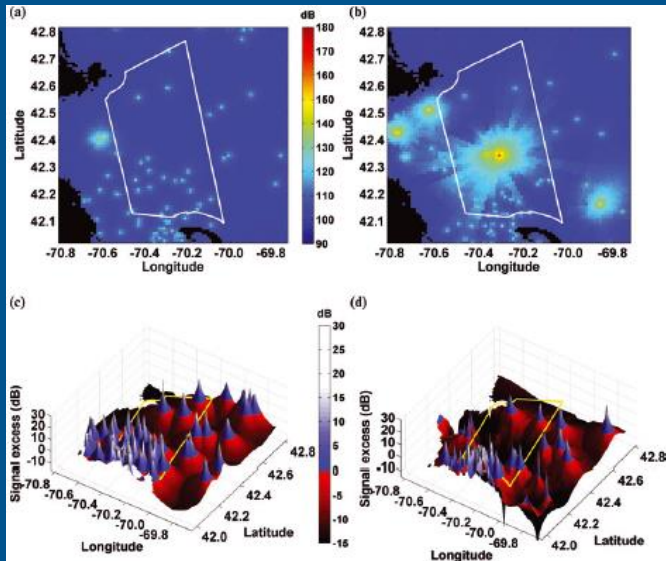
# Determining Noise Impacts



Francis & Barber (2013) *Frontiers in Ecology*

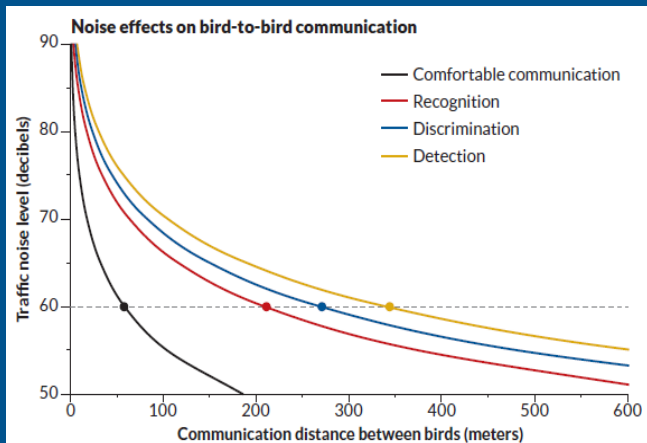


# What Lost Listening Means for Ecosystems



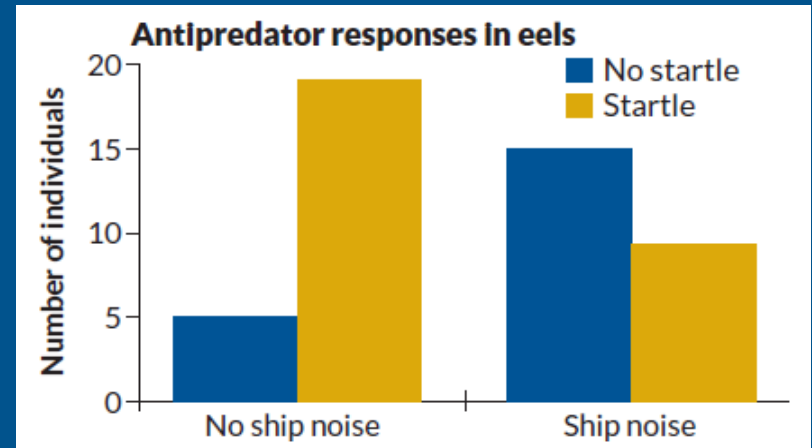
## Lost opportunities for right whale communication

*L. T. Hatch et al./Con. Bio. 2012*



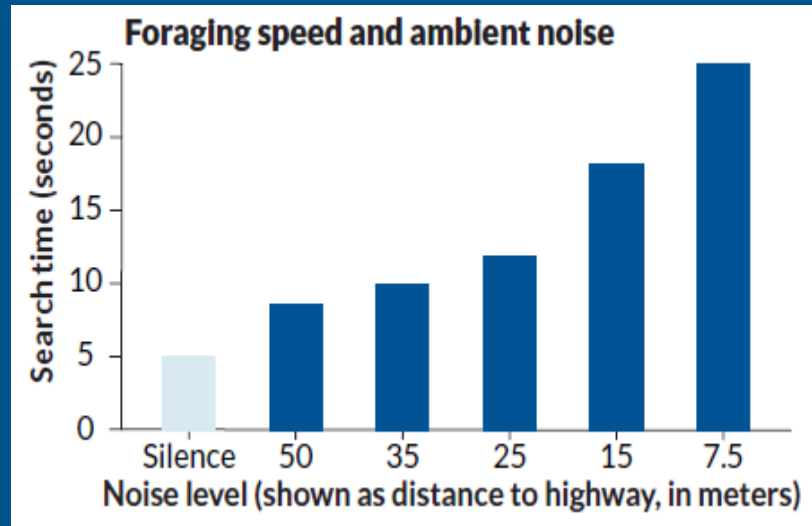
## Lost opportunities for bird communication

*R.J. Dooling et al./Proc. Instit. Acoustics 2009*



## Elevated risk of eels being predated

*S.D. Simpson et al./Global Change Biology 2015*



## Less efficient bat foraging

*B.M. Siemers and A. Schaub/Proc. R. Soc. B 2011*



# OUTLINE

- Ocean Noise: What's the Problem?
- **NOAA Ocean Noise Strategy**
- ONMS & Ocean Noise
- OCNMS & Noise

# NOAA's Responsibilities

*NOAA is the Lead US Agency Responsible for Reducing or Eliminating the Impacts of Noise on Marine Species*

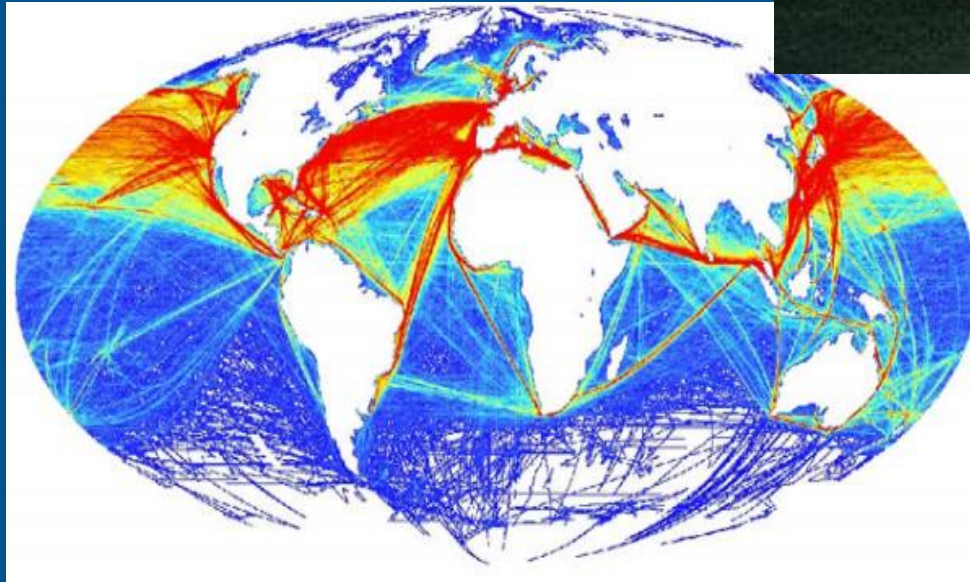
- Marine Mammal Protection Act
- Endangered Species Act
- Magnuson-Stevens Fisheries Conservation & Management Act
- National Marine Sanctuaries Act
- Coastal Zone Management Act



# Noise Management

## Current Noise Management

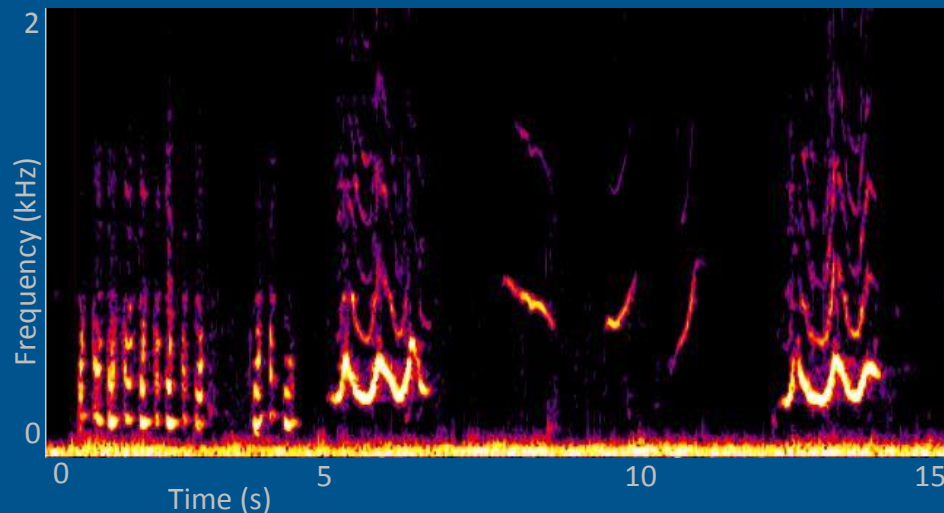
- Activity by activity
- Short term & small scale
- Thresholds for high intensity, transient sources
- Difficulty incorporating ambient noise variability
- Emphasis on impacts to marine mammals



# Noise Management

## Goals for Future Noise Management

- Cumulative footprints from multiple source types
- Ecologically-relevant scales (space & time)
- Address chronic, lower intensity sources
- Incorporate ambient noise variability
- Emphasize impacts to a variety of marine animals & their habitats





# NOAA Ocean Noise Strategy: 10 Year Vision

- Management
- Science and Monitoring
- Tools and Services
- Outreach, Collaboration & Stakeholder Engagement



Jason Thompson/CBNMS

# NOAA Ocean Noise Strategy: 10 Year Vision

*NOAA's Ocean Noise Strategy stresses a focus **on the places that animals need and the acoustic conditions of those places** to better account for whole ecosystems, the greater role of protecting hearing opportunities beyond reducing physical harm due to noise, and the many types of natural and anthropogenic sounds that are contributing to marine soundscapes.*

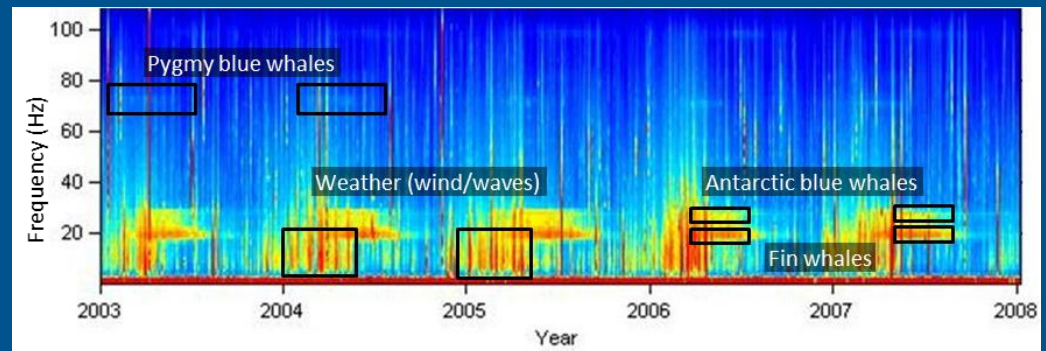
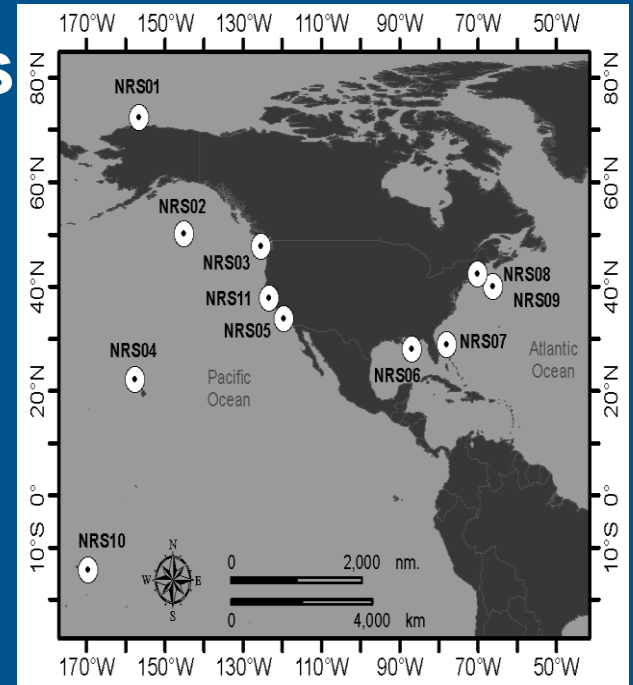
# Passive Acoustic Monitoring and Database Development

## NOAA Noise Recording Stations

- Low frequency
- Ambient Noise
- Long-term deployments
- Deep Water
- Multi-Regional comparison

## NOAA NCEI Passive Acoustic Database Pilot

- Metadata standards
- First-order data products



# Cetacean Distribution, Density & Biologically Important Areas

## cetsound.noaa.gov

### Cetacean Data Availability

This page illustrates the availability of cetacean data by regions of the US Exclusive Economic Zone (EEZ) and by month. Data sets are classified by tiers that indicate their relative quality.

Legend (Data Tier, Code, Description, Extended Code):

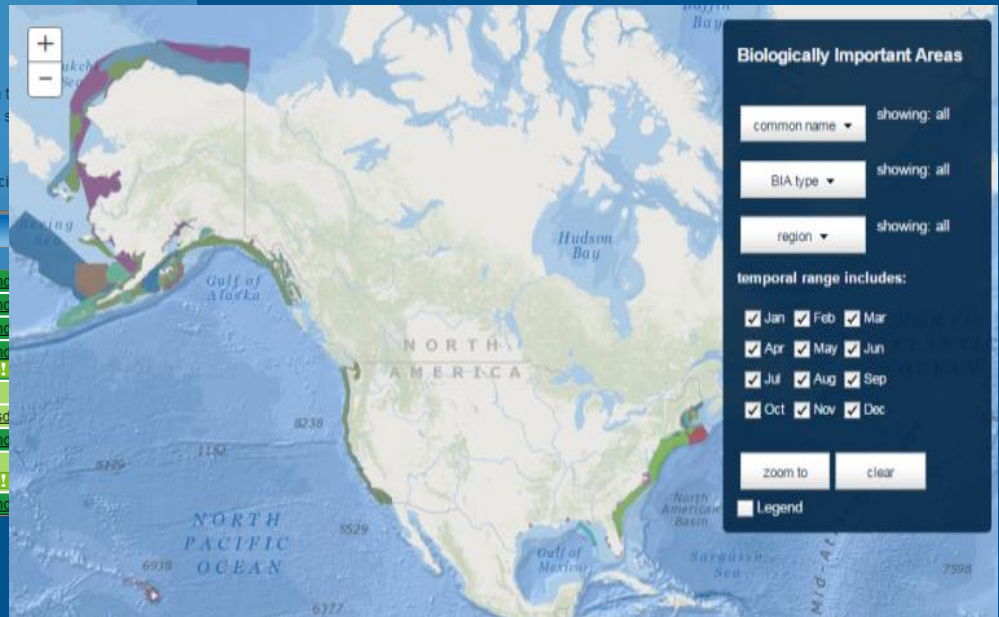
1	hd	Habitat-based Density	hde	3	po	Probability of Occurrence	poe	5	exp	Expert-based presence	expe
2	sd	Stratified Density	sde	4	rec	Records Exist	rece	5	exa	Expert-based likely absence	exae

NOTE: Expert-based presence for each species was designated at the temporal resolution of an entire year, such that "present" if it is known to occur in that region at any time during the year. This tier does not provide information on specific months.

Show data availability for Region = West Coast (WC) ☒ Hide rows where species is not present

Region	Species	Package	J	F	M	A	M	J	J
▲ WC									
▼	Baird's beaked whale		rec	rec	rec	rec	rec	rec	hc
▼	Beaked whales (general)		sde	sd				rec	rec
▼	Blainville's beaked whale		exp						hc
▼	Blue whale		sde	sd				rec	hc
▼	Bottlenose dolphin		sd						
▼	Bryde's whale		rec					rec	sd
▼	Common dolphin		rec	rec	rec	rec	rec	rec	hc
▼	Common porpoise		sd	!	!	!	!	!	!
▼	Cuvier's beaked whale		rec	rec	rec	rec	rec	rec	hc

Duke Marine Lab

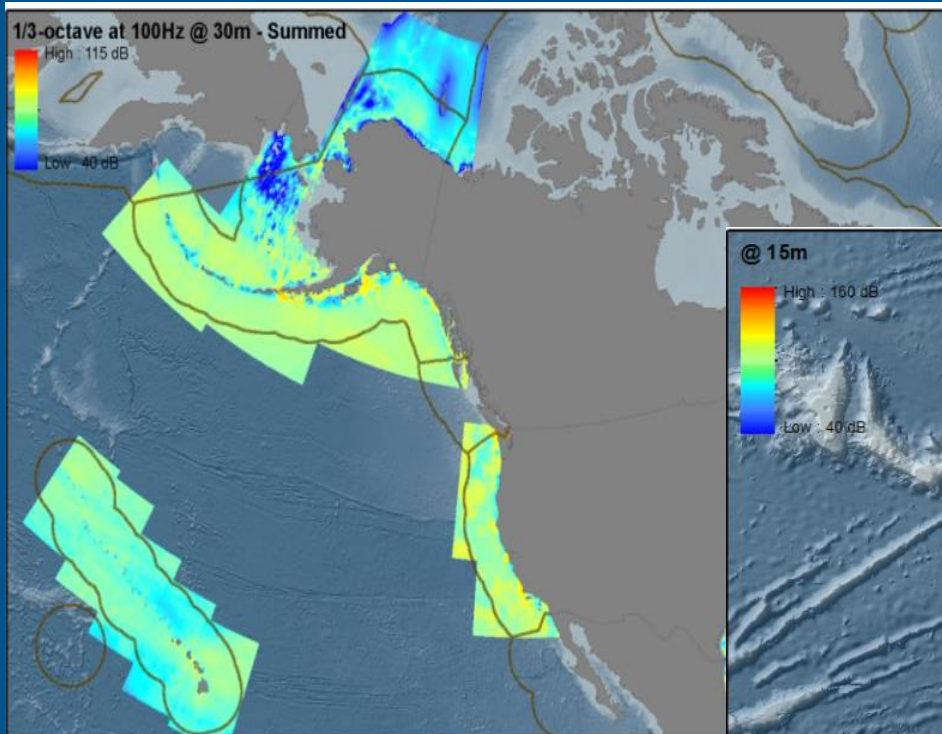


Aquatic Animals

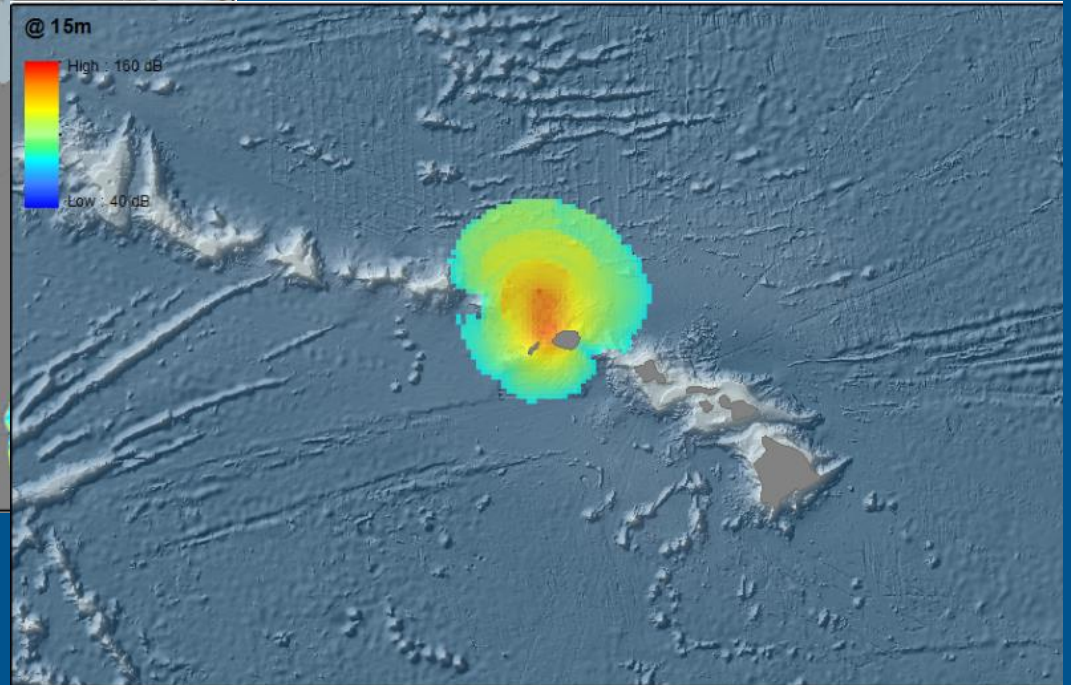


# Underwater Sound Field Mapping

[cetsound.noaa.gov](http://cetsound.noaa.gov)



HLS Research



e.g., NAEMO

# Place-based Risk Assessment

## Southwestern US

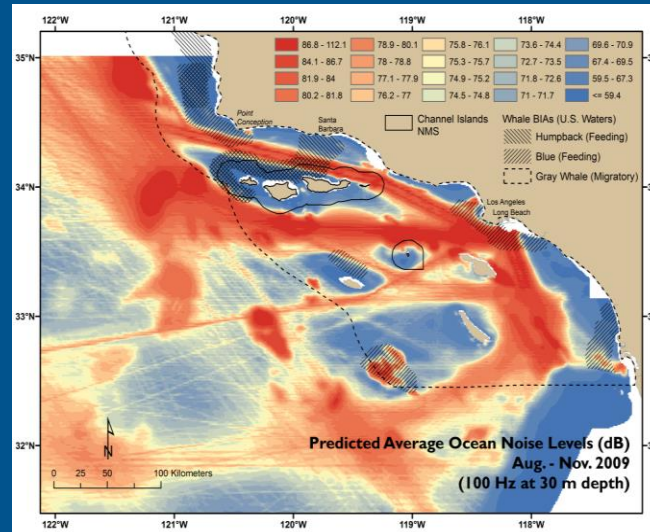
e.g.,:

- CINMS
- Baleen whale feeding and migration
- Shipping
- Navy training

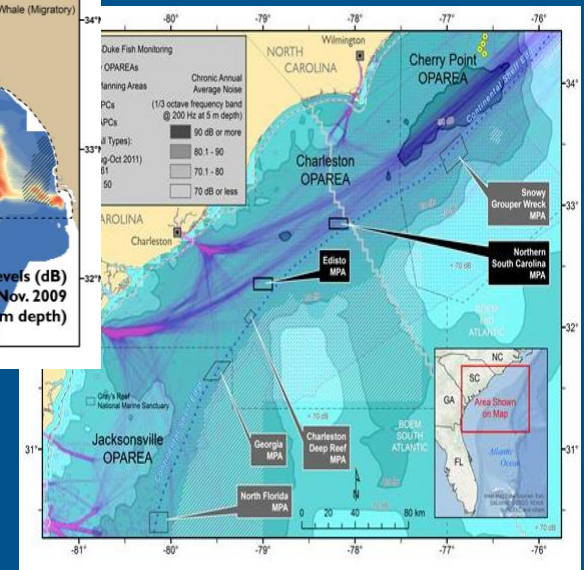
## Mid Atlantic US

e.g.,:

- Fishery HAPCs
- Baleen whale migration
- Shipping
- Energy development
- Navy training



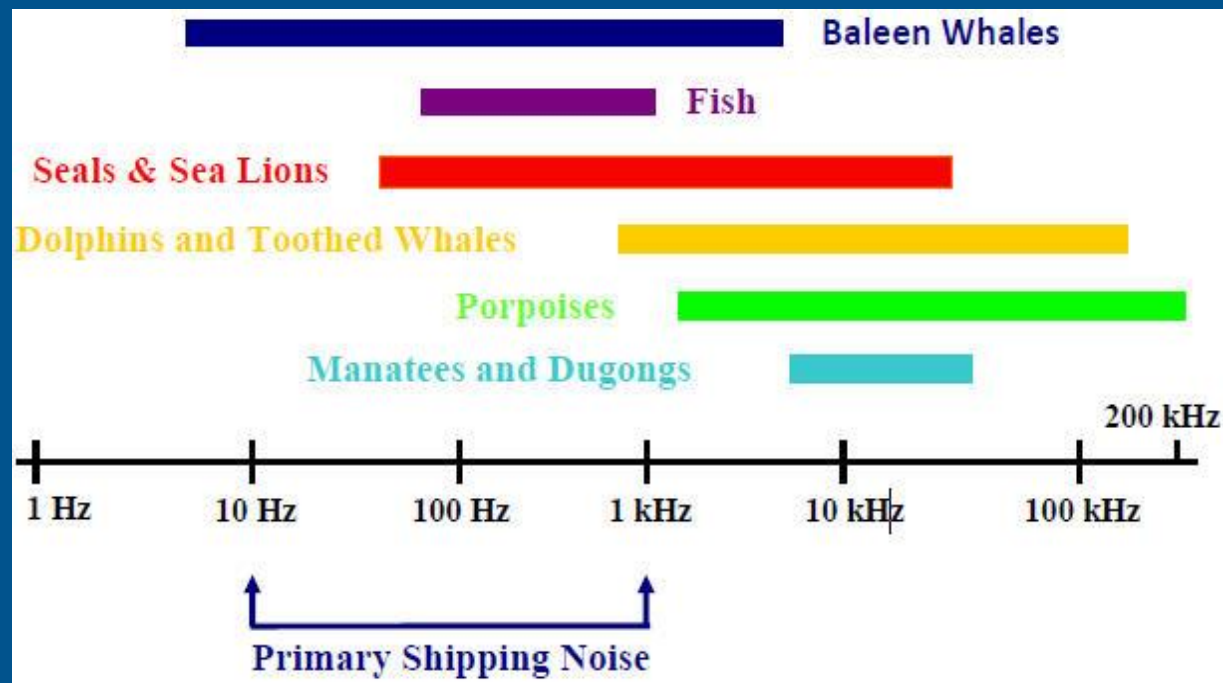
*Redfern et al. (submitted)*



# Bringing NOAA's Noise Management to Scale: SPACE

**Example: Reduce Wide-Ranging, Low Frequency Propagation by Supporting the Design & Use of Quieter Alternatives**

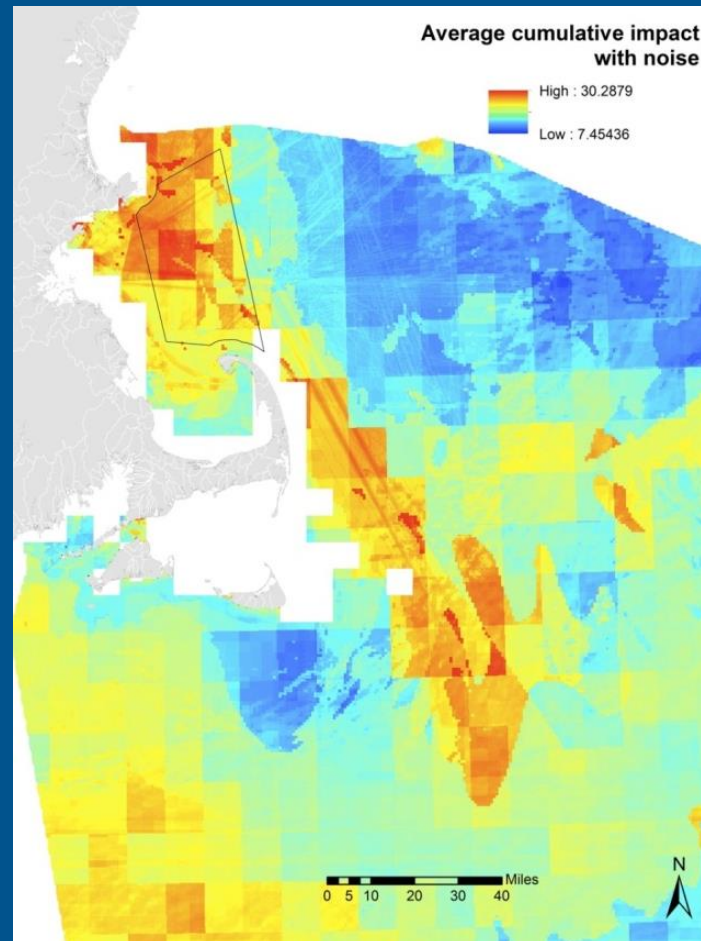
- Merchant Shipping
- Airguns



# Bringing NOAA's Noise Management to Scale: TIME

## Example: Link Project by Project Actions to Address Accumulated Exposure

- Single Sector
- Multi-sector





# Bringing NOAA's Noise Management to Scale: Ecology

## Example: Link Taxonomically-Specific Authorities to Broader Area-based Authorities & Initiatives

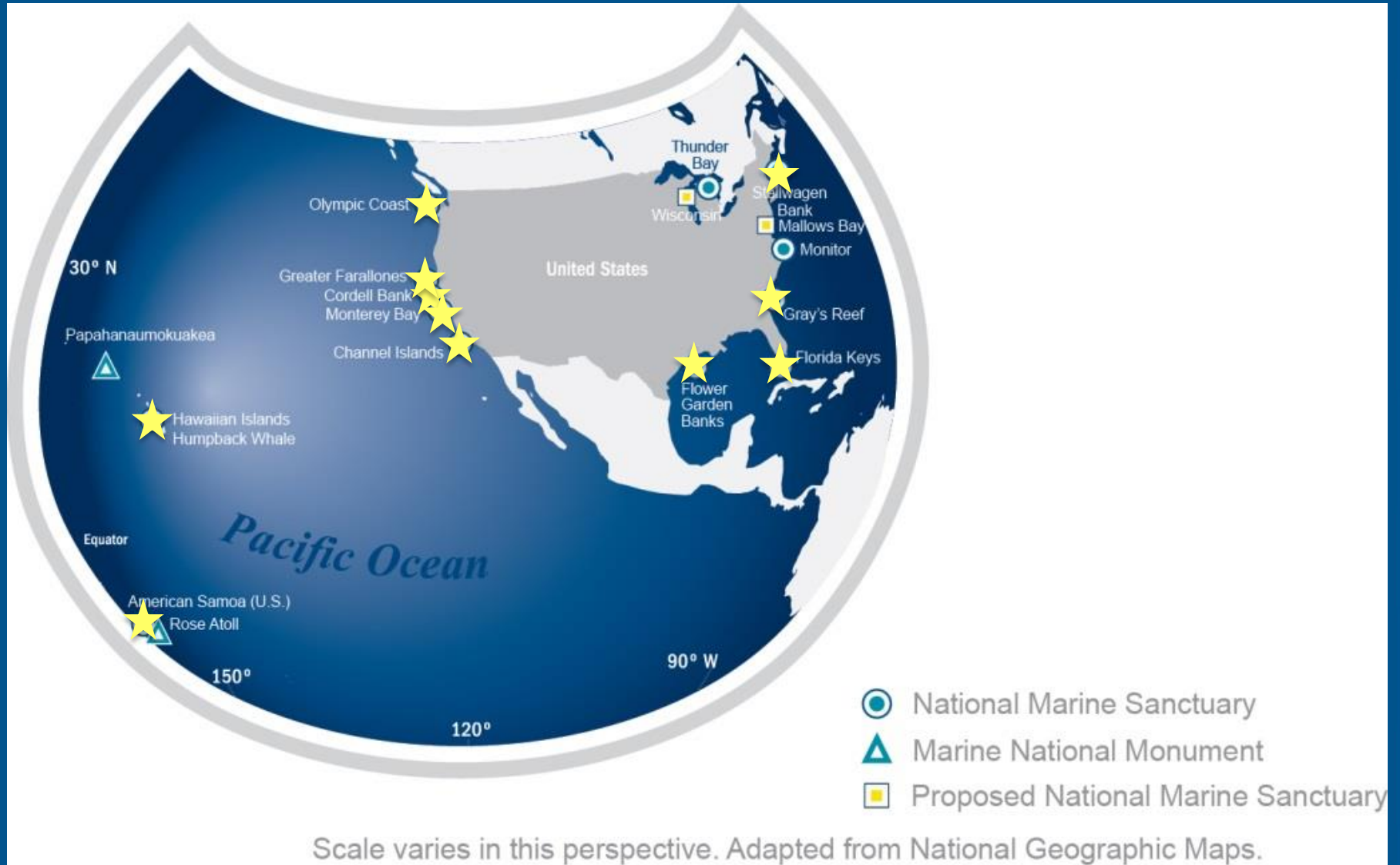
- Marine Protected Areas & Acoustically Sensitive Species
- Ecosystem-based Management & Acoustic Habitats



# OUTLINE

- Ocean Noise: What's the Problem?
- NOAA Ocean Noise Strategy
- **ONMS & Ocean Noise**
  - Policy and Planning
  - Conservation Science
  - Outreach and Communication
- OCNMS & Noise

# Noise and the ONMS



# Noise and the ONMS

- **Policy and Planning**
- **Conservation Science**
- **Outreach and Communication**



mojoscoast~2015

Jason Thompson/CBNMS



# Strategy in Action in ONMS: **Policy and Planning**

1. NMS Act Consultations  
and NEPA (Inter and  
Intra Agency Work)
2. SAC Engagement
3. Management Planning

# Strategy in Action in ONMS: Policy and Planning

1. NMS Act Consultations and NEPA (Inter and Intra Agency Work)
2. SAC Engagement
3. Management Planning

## *Recent Examples include*

- *Navy*
- *BOEM*
- *NOAA fisheries*

# Strategy in Action in ONMS: Policy and Planning

1. NMS Act Consultations and NEPA (Inter and Intra Agency Work)
2. SAC Engagement
3. Management Planning

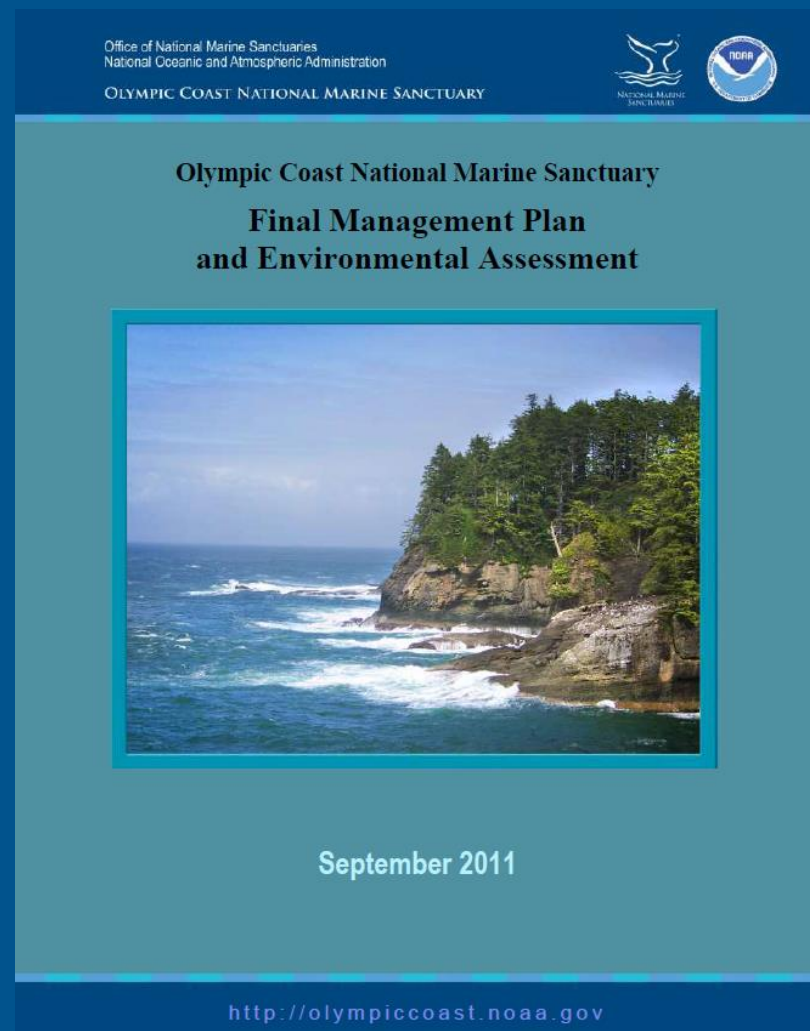


- *Presentations*
- *Letters from SACs to ONMS Director calling for increased attention to noise*

# Strategy in Action in ONMS: Policy and Planning

1. NMS Act Consultations and NEPA (Inter and Intra Agency Work)
2. SAC Engagement
3. Management Planning

*Several sites looking to include or expand on noise as a topic in Management Plans*





# Strategy in Action in ONMS: **Conservation Science**

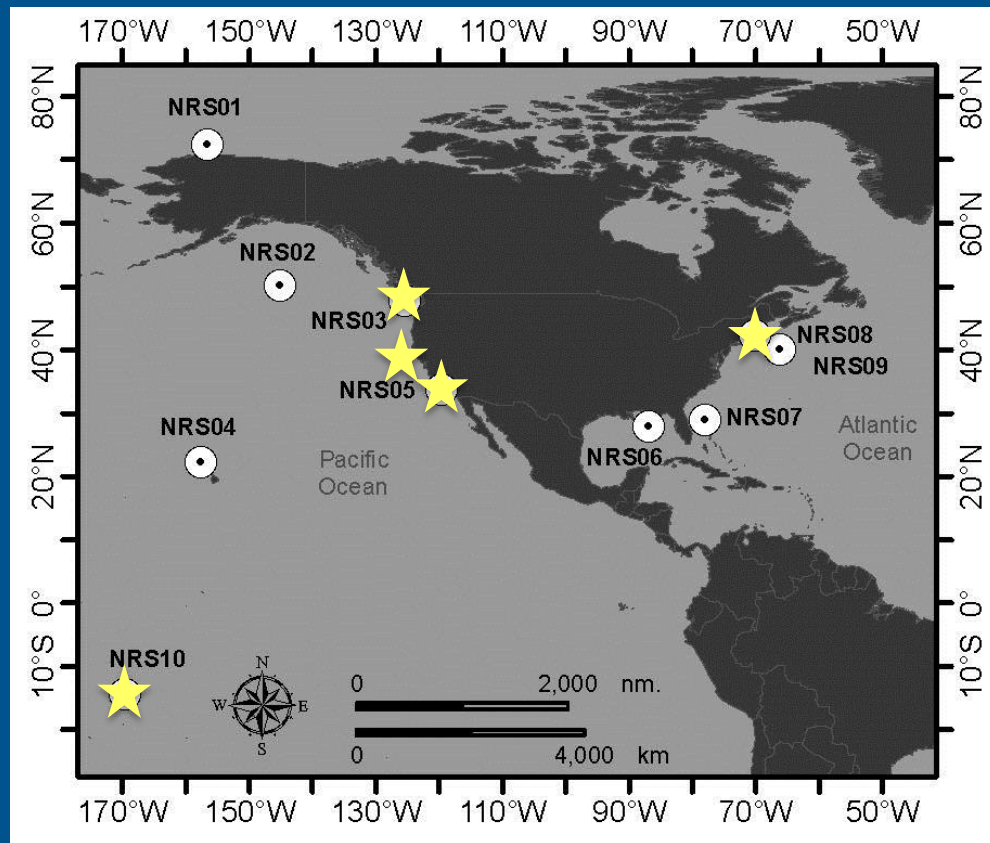
1. Integration into NOAA-level activities
2. Sanctuary System Integration
3. Site Level Activities

# Strategy in Action in ONMS: Conservation Science

1. Integration into NOAA-level activities
2. Sanctuary System Integration
3. Site Level Activities

*NOAA Noise Recording Stations in or near sanctuaries*

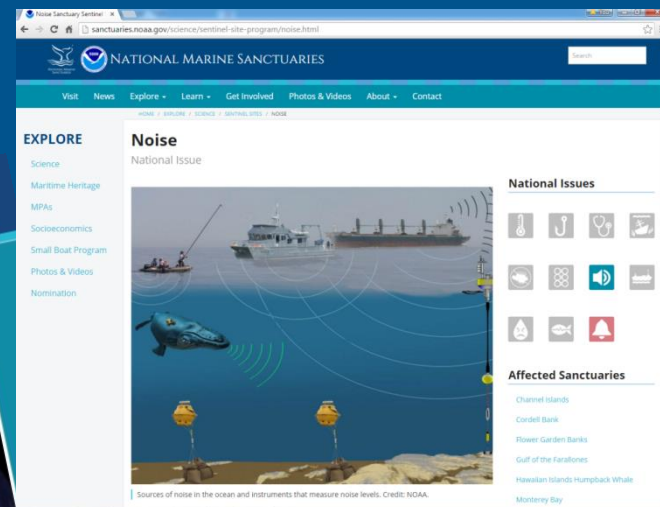
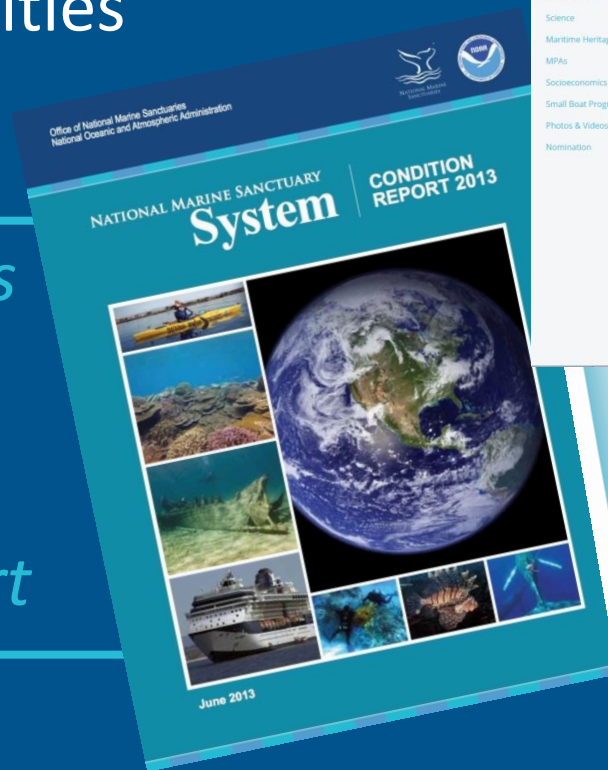
- *CI, SB, CB, NMSAS, and OC*
- *Potential plans for GR, MB, FG*



# Strategy in Action in ONMS: Conservation Science

1. Integration into NOAA-level activities
2. Sanctuary System Integration
3. Site Level Activities

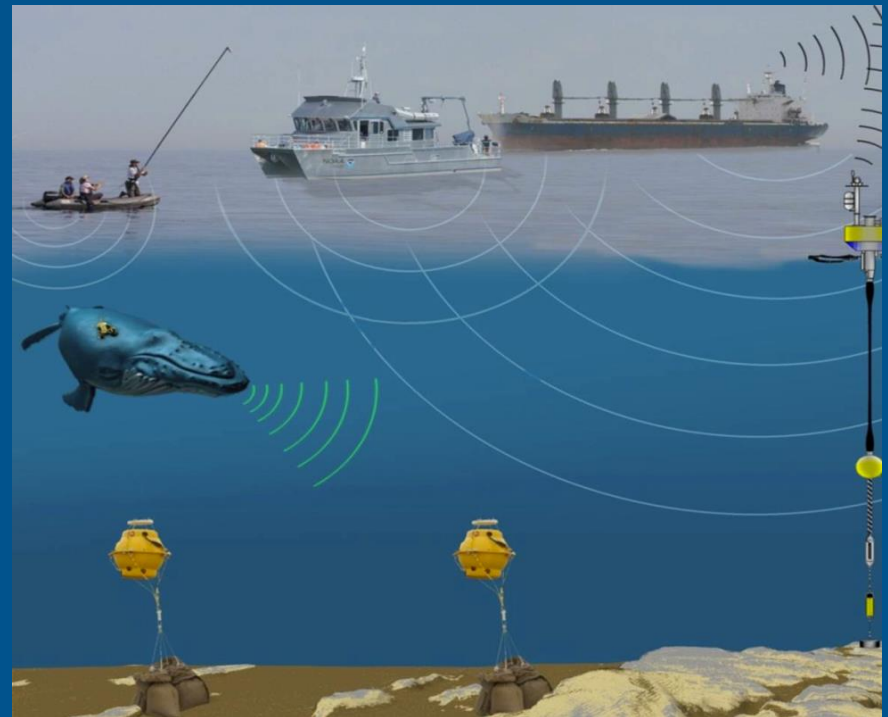
- *Condition Reports*
- *Science Needs Assessments*
- *Sentinel Site Effort*



# Strategy in Action in ONMS: Conservation Science

1. Integration into NOAA-level activities
2. Sanctuary System Integration
3. Site Level Activities: “Test Bed for Science”

- *Gray's Reef*
- *HI Humpback Whale*
- *Monterey Bay*
- *Channel Islands*
- *Stellwagen Bank*





# Strategy in Action in ONMS: Outreach and Communication



## MONTEREY BAY NATIONAL MARINE SANCTUARY



Home | About MBNMS | Resource Protection | Education & Outreach | Research & Monitoring | Get Involved | Advisory Council | Materials & Resources

### Resource Protection

- Overview
- General Information
- Ecosystem-Based Management
- Permits, Regulations, & Enforcement
- Water Quality
- Maritime Heritage
- Resource Issues
- Acoustic Impacts
- Aircraft, Model Aircraft, & Drones
- Climate Change
- Coastal Armoring & Erosion

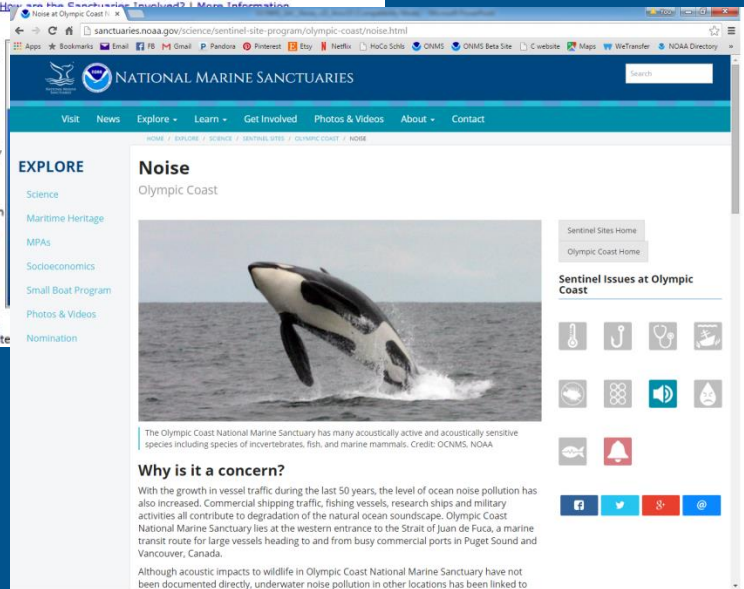
### Resource Issues: Acoustic (Noise) Impacts

Acoustic (Noise) Impacts | How are the Sanctuaries Involved? | More Information

#### Noise in the Ocean

Noise generated by human activities can have a detrimental effect on marine life. Studies have documented behavioral responses, lost listening opportunities, and physical injuries in wildlife due to exposure to anthropogenic (human-induced) noise. Sources of underwater noise include large commercial shipping traffic such as container ships, freighters, barges and tankers; smaller recreational and commercial vessels; sonars used in military training; pile drivers and dredging used in marine construction; airguns and other seismic sources used in energy exploration; sonars and other active acoustic sources used in research activities; and aerial sources such as overflights.

This issue is important for the five West Coast Sanctuaries, including Monterey Bay National Marine Sanctuary (MBNMS) since the West Coast of North America is one of the busiest container-shipping routes.



ONMS Quick Chats  
Webinar and Discussion Forum

# ONMS Noise Team

- Technical lead
  - Dr. Leila Hatch (SBNMS)
- Policy and Planning
  - Vicki Weddell (ONMS HQ)
  - Leila Hatch (SBNMS)
- Conservation Science
  - Mitchell Tartt
  - Kathy Broughton
  - Leila Hatch
- Outreach and Communication
  - Paul Chetirkin (Videos)
  - Liz Weinberg (Social Media)
- Site Representation
  - Becky Shortland (GRNMS)
  - Dani Lipski (CBNMS)
  - Karen Grimmer (MBNMS)
  - Jon Martinez (HIHWNMS)

# ONMS Noise Team

## *2015/16 areas of focus*

1. Science
2. Support Policy and Management
3. Expertise and capacity development for the ONMS
4. Fundraising and Partnership
5. Public Education and Outreach



# OUTLINE

- Ocean Noise: What's the Problem?
- NOAA Ocean Noise Strategy
- ONMS & Ocean Noise
- **OCNMS & Noise**



# OCNMS

## Diverse, Vocally-Active Cetacean Populations

- Well studied (tagging, passive acoustic monitoring)
- Predictable presence of low, mid and high-frequency acoustically active and sensitive species

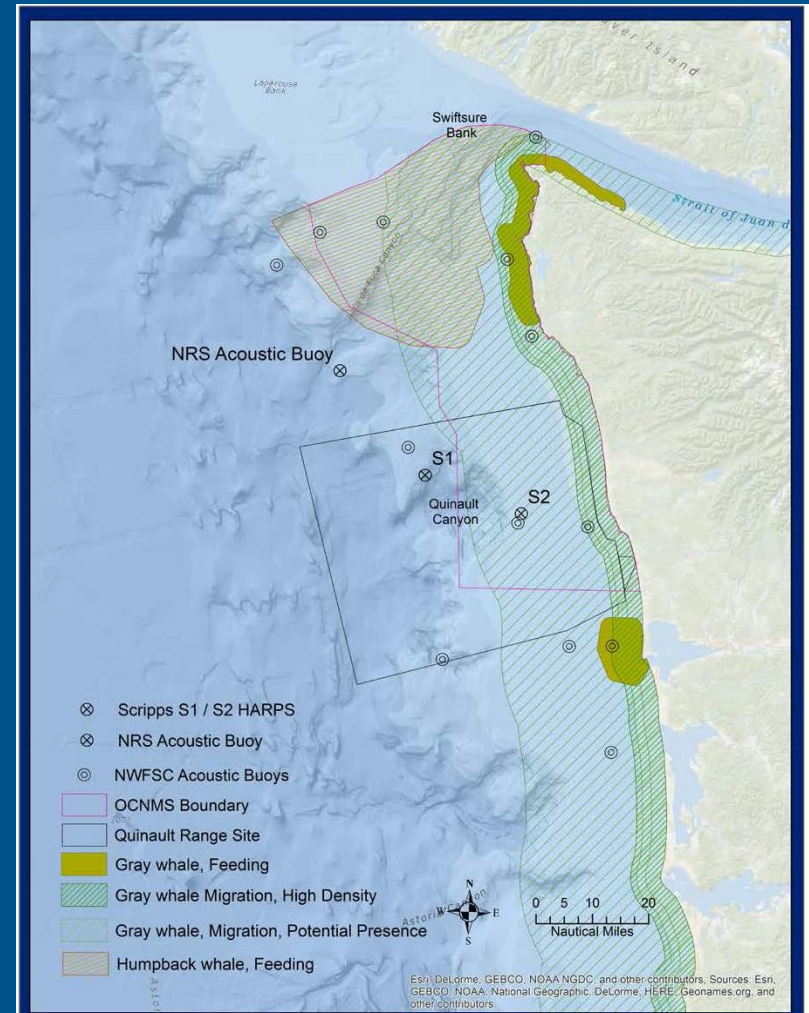
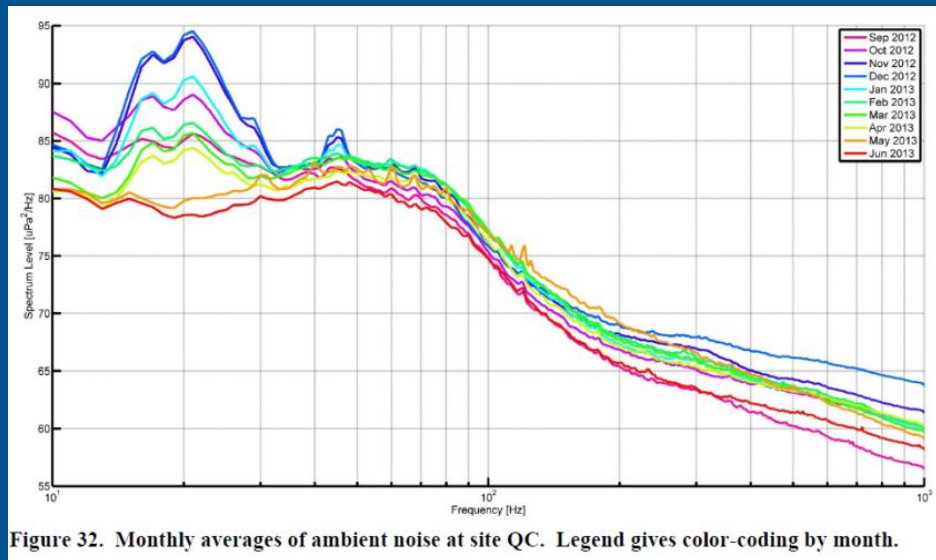


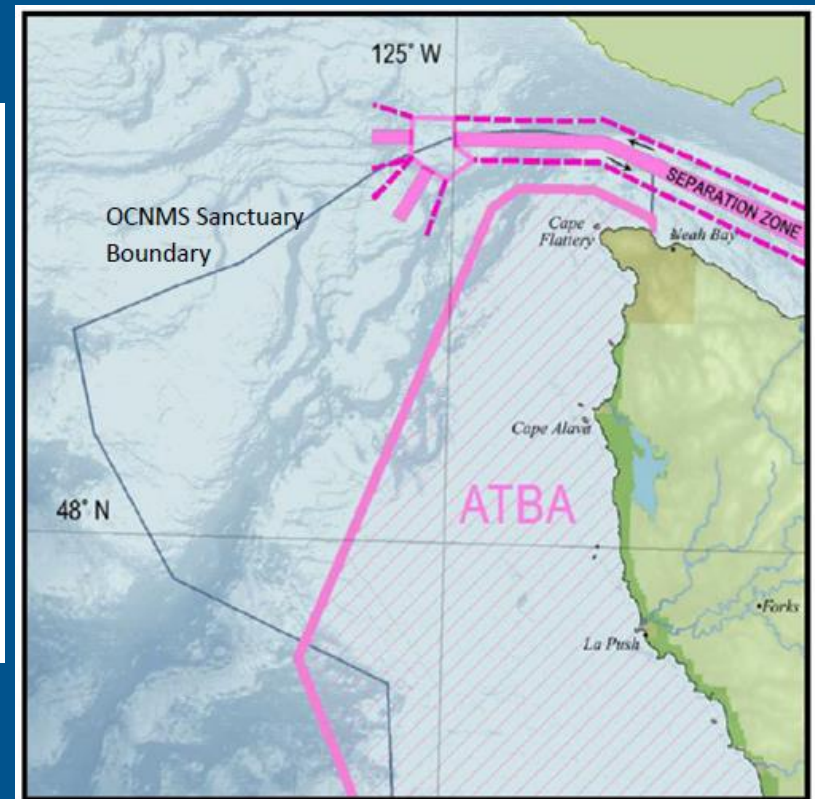
Figure 2. Biologically important areas for marine mammals

# Chronic Low Frequency Noise Exposure: OCNMS and Shipping

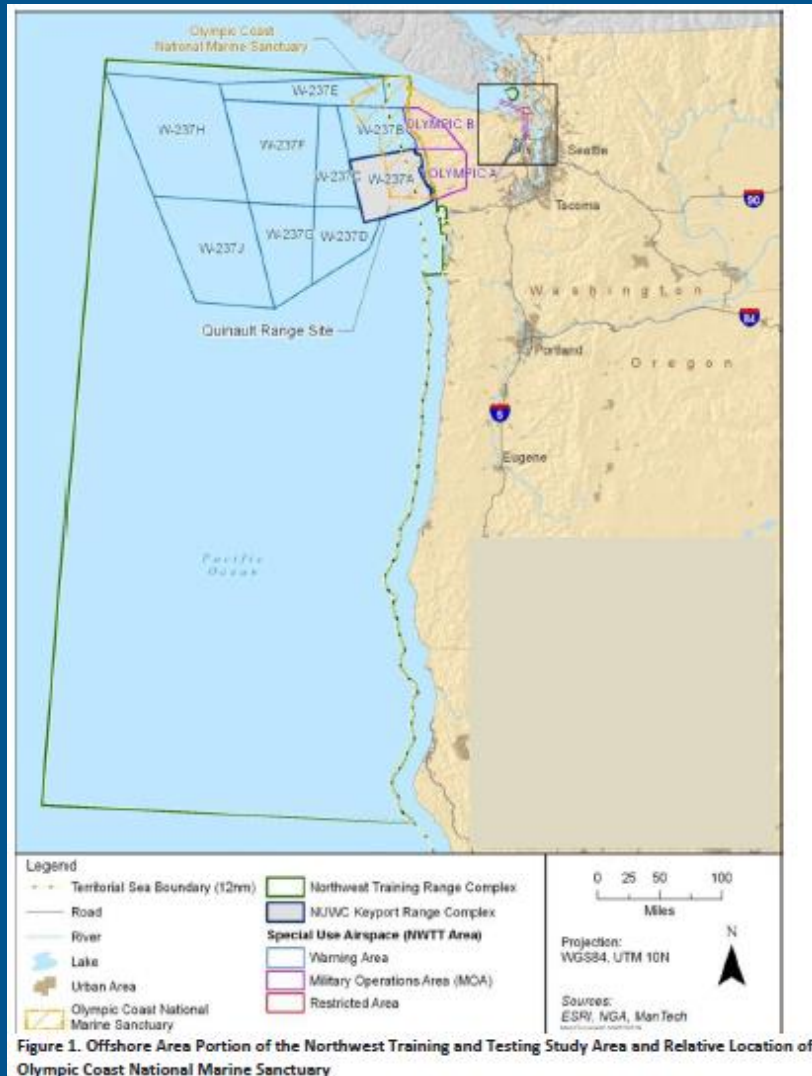
*Northern (lanes) vs. On Shelf (ATBA) vs. Shelf-Break (offshore propagation)*



Debich et al., 2014



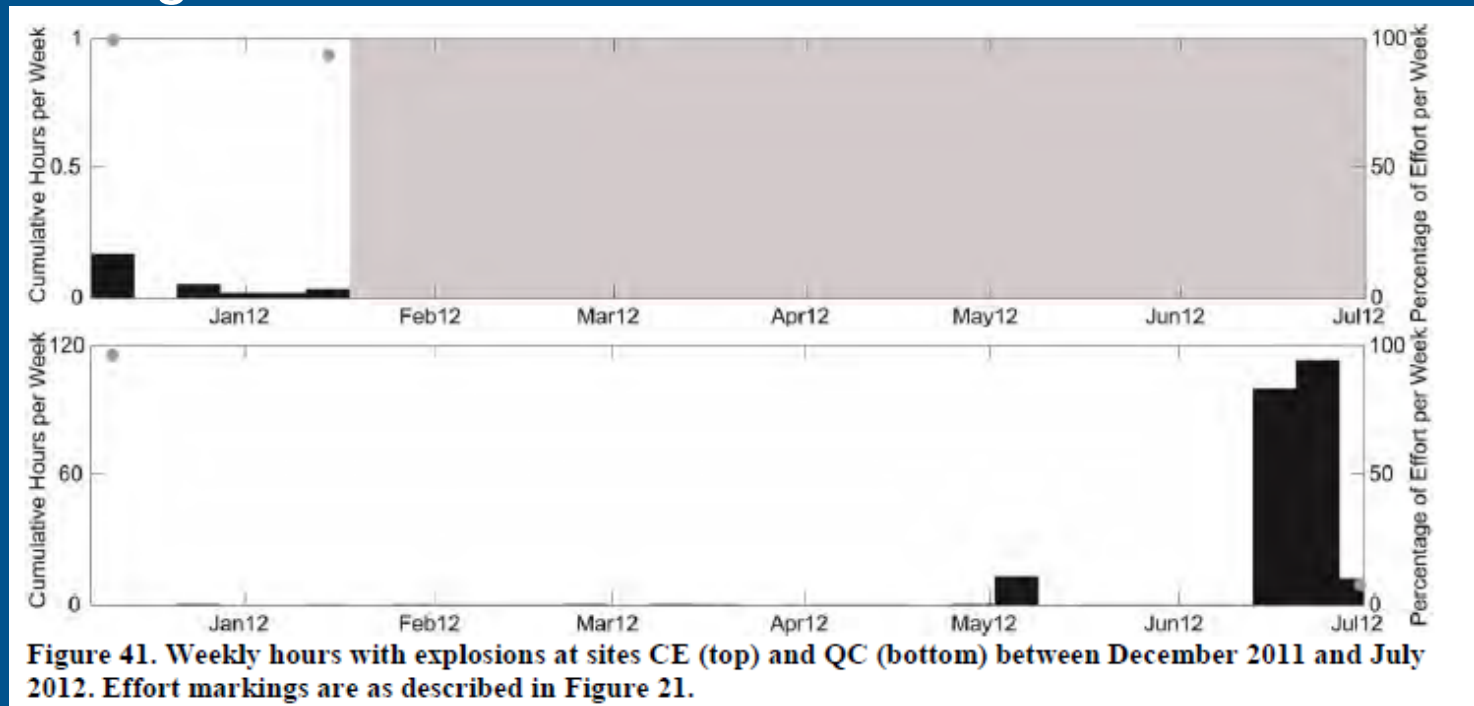
# Accumulated Acute Noise Sources: OCNMS and the Navy



- Diversity of active acoustic sources (no explosives within site)
- Training is mostly distant from OCNMS
- Quinault Range supports diverse testing activities inside and adjacent to OCNMS

# Accumulated Acute Noise Sources: OCNMS and non-Navy

- Non-Navy explosive use detected (could be within or in proximity to sanctuary)
  - Seal-bombs used in fishing
  - Airguns





# Long Term Passive Acoustic Monitoring in NWTRC

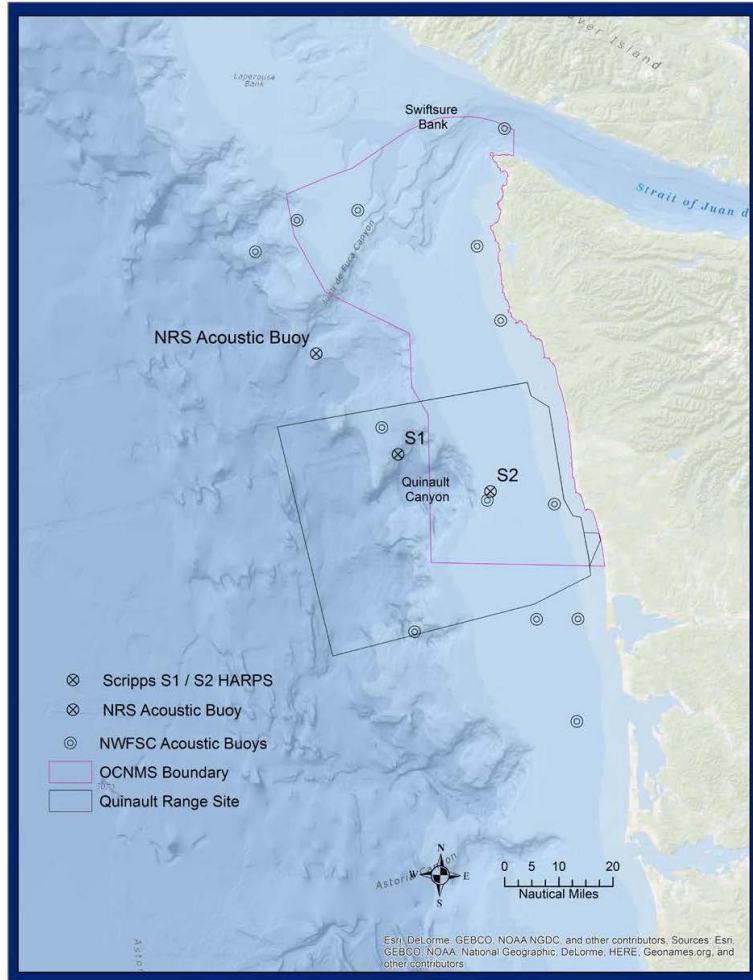


Figure 1. Outer coast of Washington state, Olympic Coast National Marine Sanctuary, Navy Quinault Range Site, and acoustic receiving moorings.

- Navy-funded HARPS
  - 2 locations monitored for 9 years (2004-15)
- Current (2015 start) NWFSC-led study uses extensive acoustic array focused on offshore killer whale behavior

# Cross-Federal NW PAM Investment



- Better coordinate/ manage long-term recording data US EEZ wide
- NW shows mix of long-term NMFS EARS and Navy-funded HARPs
- New NOAA NRS investment (2014 start)

## **Broader Ecological Focus?**

### **OCNMS Management Plan:**

“Noise pollution, or the cumulative acoustic signature of human activities, is an aspect of the pelagic habitat of OCNMS not currently well characterized or evaluated for potential impacts on wildlife in the sanctuary.”

## Broader Ecological Focus?

- **FISH** : salmonids less acoustically sensitive than other fish; sharks, rockfish, mackerels, possible influence
- **TURTLES**: lower frequency sensitivity, possible effect of masking of important signals by shipping noise
- **INVERTEBRATES**: increasingly well documented acoustic activity and sensitivity of urchins, crabs, shrimp and lobsters among other species



## Take Home Messages

1. NOAA is working to address both chronic and acute ocean noise impacts
2. NOAA is working to better protect the acoustic condition of high value places
3. ONMS has a system-wide approach to ocean noise
4. OCNMS includes many acoustically active cetacean species (many endangered)
5. OCNMS is impacted by both chronic and accumulated acute noise sources
6. OCNMS has a relatively strong information base to consider noise within management planning